Low-Cost Options for Moderate Levels of Mercury Control

Quarterly Progress Report
Reporting Period: April 1, 2006–June 30, 2006

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DISCLAIMER

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EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) Cooperative Agreement number DE-FC26-05NT42307 “Low-Cost Options for Moderate Levels of Mercury Control,” covers an award for funding a project that will investigate and test the Electric Power Research Institute’s (EPRI) patented TOXECON II™ process on two cold-side precipitator-equipped plants, and investigate and test the use of high-temperature sorbents on two hot-side precipitator-equipped plants. The DOE made this award through the National Energy Technology Laboratory (NETL) on February 17, 2005.

The project will conduct tests at four different sites: TOXECON II™ at two sites and high-temperature reagents/sorbents at two sites. Table 1 shows a summary of the test configurations.

Table 1. Host Site NETL Area of Interest.

Area of Interest	AEP Gavin (tentative)	Entergy Independence	MidAmerican Council Bluffs	MidAmerican Louisa
Technology	TOXECON II™		High-Temperature Reagents/Sorbents	
Low-rank fuels		X	X	X
Bituminous fuels	X			
Test size (MW)	200	105	88	350
Longer-term tests (1–2 months)	X	X	X	

This report covers the project activities for 2Q06.

During 3Q05, ADA-ES and the host site completed the test equipment installation and an abbreviated baseline and parametric testing sequence at Entergy’s Independence Station. ADA-ES halted the originally planned sequence because electrostatic precipitator (ESP) Field 7 (F7) was out of service because of equipment malfunction.

During 4Q05, ADA-ES started a second testing sequence on September 28, 2005, including a repeat of the baseline and parametric sequence, and ran the long-term testing sequence. The long-term testing sequence finished on November 7, 2005. At the end of the long-term testing sequence, ADA-ES ran a one-week test sequence with carbon-ash reinjection. The field-testing for Independence concluded on November 15, 2005.

Although not a part of this project, ADA-ES continued with a follow-on testing program concentrating on a long-term operational demonstration through EPRI.

During 1Q06, at Louisa, ADA-ES issued a draft of the test plan, which included the results of discussions between ADA-ES and MidAmerican for the high-temperature sorbents testing at that plant. Testing took place during the weeks of January 23, January 30, and February 6, 2006.

During the current quarter, 2Q06, ADA-ES ran the sorbent screening tests at Council Bluffs for high-temperature pre-ESP sorbents with mostly unsuccessful results. Testing took place the week of April 17, 2006. We also continued to investigate the use of the MinPlus high-temperature furnace injected sorbent, and began computational fluid dynamics (CFD) modeling on the furnace for this effort.

This report is intended to cover the general status of the project and the general results and observations during the reporting period. It does not cover the testing results in detail. The Topical Report for the testing program at each testing site, when published, will present the detailed testing data and results, and give an in-depth analysis of the observations and findings.

RESULTS OF WORK

Approach

This period covers the sixth quarter of project activities, primarily the continuation of data analysis activities for the TOXECON II™ testing at Entergy's Independence Station, the high-temperature reagent injection at MidAmerican's Louisa Station, and the preparations and sorbent screening testing of high-temperature sorbents at MidAmerican's Council Bluffs Station.

Results and Discussion

Project General

TOXECON II™ Description

The TOXECON II™ technology injects reagents and/or sorbents directly into the downstream collecting field(s) of an ESP. Since the ESP collects the majority of the fly ash in the upstream collecting fields, only a small portion of the total collected ash contains reagents/sorbents with this injection configuration. The TOXECON II™ technology requires minimal capital investment compared to other alternatives because it requires only minor retrofits to the ESP for the carbon injection system instead of installing a separate secondary particulate control device.

In this process, the sorbent injection lances are located within the ESP box, injecting sorbent across the front face of a downstream field. A normal sorbent storage silo and feeder system provides the sorbent to the injection grid. The location of the injection grid is dependent on the ESP SCA, the number of fields in the ESP, and the physical size of the fields.

Since the sorbent/ash mixture collected from the latter fields is primarily sorbent, this process also allows for the possibility of recycling the partially spent sorbent back into the process to achieve greater sorbent utilization and thus lower overall sorbent costs.

Figure 1 shows the general configuration and the typical sampling for the TOXECON II™ process.

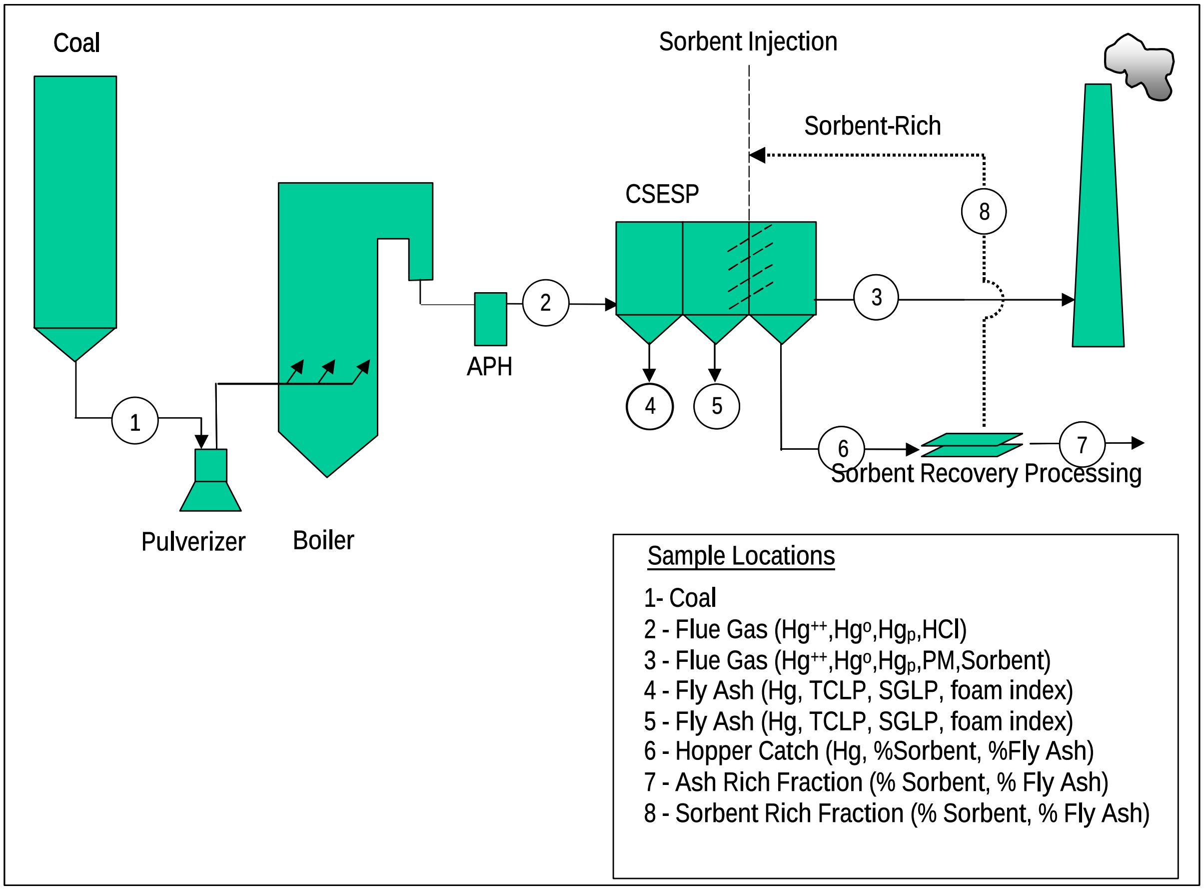

Figure 1. General Configuration and Sampling in TOXECON II™ Tests.

High-Temperature Sorbents

The testing of high-temperature sorbents/reagents in this project will investigate possible approaches to removing mercury from plants that have hot-side electrostatic precipitators. There is very little experience to date on removing mercury with this configuration. This part of the project will investigate both liquid and dry sorbents/reagents in applications that use hot-side ESPs.

The liquid sorbents/reagents portion will include injecting a liquid reagent in front of the ESP and a liquid reagent on the coal feed to the mills, both at Louisa.

The solid sorbent/reagent portion will include injecting solid sorbents/reagents in front of the ESP as well as in the furnace or the heat recovery area of the boiler, both at Council Bluffs.

Entergy Independence Station – TOXECON II™

Site Description

The Entergy Independence Steam Electric Station consists of two 840-MW PRB coal-fired electric generating units. Testing for this project is on Unit 2.

These units are balanced draft Combustion Engineering tangentially fired divided furnace boilers, Ljungström regenerative air heaters, and CE Walther rigid frame cold-side electrostatic precipitators. The ESP for each generating unit has four boxes in a two-wide by two-high stacked arrangement, with each box consisting of eight transformer/rectifier (T/R) sets, sixteen physical fields arranged in a four-wide by four-deep configuration, and with each T/R set powering two physical fields. The ESP boxes are designated A, B, C, and D. The gross SCA at design flow is 540 ft^2/kacfm.

The inlet and outlet ducts for each box are split into two separate ducts, making it convenient to have a test portion and a control portion in the same ESP box. Sorbent injection testing will take place on one-half of one box, or one-eighth of the total flue gas flow.

This project installed specially designed injection grids for this test between the second and third fields and between the third and fourth fields. This allows collecting the injected sorbent at either an effective SCA of 270 ft^2/kacfm (two fields) or of 135 ft^2/kacfm (one field).

The carbon injection system for the parametric tests consisted of a portable feeder-blower unit that feeds the sorbent from 900-lb capacity bulk-storage bags. With the normal parametric testing injection ranges, this configuration allowed testing a single sorbent for approximately 8 hours using a single bulk-storage bag. The feeder on this unit is a variable speed screw feeder that allows testing at various injection rates.

The carbon injection system for the long-term tests consisted of a storage silo with an approximately 20-ton storage capacity. Sorbent feeds from the silo into two feeder trains that mix the sorbent with transport air and convey it to the injection grid connections at the top of the test ESP box, into the injection grids, and into the gas stream inside the ESP. The transport air quantity is constant, but a variable speed screw feeder meters the sorbent into the transport air through an eductor. This allows testing at various sorbent injection rates.

The plant ash handling system is a dilute-phase pressure system with pressure feeders at each ESP hopper outlet and two storage silos, normally one for each generating unit. With minor modifications to the ash transport system, the ash/carbon mixture from the four hoppers under the test fields is segregated and transported to a dedicated silo.

For collection of plant operating data, the test site has a workstation connected to the plant control and information system that makes the necessary plant data immediately available to the testing efforts.

Figures 2 and 3 show the carbon injection system and the injection grids for the test installation at Independence.

Figure 2. Long-Term Test Injection Silo.

Figure 3. Injection Grid between ESP Fields.

The project measured the mercury levels in the gas streams using semi-continuous emission monitors (SCEMs), Ontario Hydro method duct traverses, and sorbent trap method (STM) samples. It measured particulate emissions using two BHA CPM 5000 particulate monitors (one across the ESP outlet duct on the test half and the other across the ESP outlet duct on the control half). It also used a TEOM particulate monitor in the ESP outlet duct on the test half, EPA Method 5 or Method 17 duct traverses, and data collection from the Unit 2 plant opacity monitoring system.

Field Testing

General

During 3Q05, Entergy arranged for a contractor to perform the following:

- Erect the silo and skid on the foundation at the site
- Install four ports on the outlet ducts of ESP "B" for the particulate monitors
- Clean the existing test ports at both the inlet and outlet ducts on ESP "B"
- Install the necessary scaffolding for access to the existing test ports on the inlet and outlet ESP ducts and for the CPMs
- Construct an analyzer enclosure on the grating at the top of ESP "B"

In addition, ADA-ES:

- Installed two mercury SCEMs including the extraction probes and the sample conditioning trains
- Set up the site office trailer
- Contracted with METCO Environmental for source testing
- Prepared and issued the Sample Data Management Plan
- Installed the BHA CPM and the TEOM 7000 particulate monitors

ADA-ES also started the testing series with an abbreviated set of baseline and parametric tests, but halted the tests due to plant operating problems, and restarted the testing efforts on September 28, 2005. Based on the information from the original parametric tests, the project selected DARCO® Hg-LH as the long-term testing sorbent.

During 4Q05, ADA-ES completed the restarted testing series, including baseline, parametric, and long-term testing, performed a short sorbent/ash recycle test sequence, and began the sample analyses and overall data reduction efforts for all of the collected data.

During 1Q06 and 2Q06, ADA-ES completed the majority of the sample analysis, progressed with the efforts to combine the various data sources, and began preparation of the Independence Site Topical Report.

Baseline Tests

August 15–21, 2005, and September 28–30, 2005

Please refer to the previous project quarterly reports for specific detailed information on the baseline testing.

In summary, both the initial baseline test series and the second baseline test series show that there is a low level of native removal for this unit. This is due primarily to very low LOI carbon in the ash exiting the boiler and very low levels of halogens in the coal. Generally, data show that the average native removal is approximately 10%.

Parametric Tests

August 22–25, 2005, and October 1–8, 2005

Please refer to the previous project quarterly reports for specific detailed information on the parametric testing.

In summary, the parametric testing at Independence evaluated four powdered activated carbon sorbents: DARCO® Hg, DARCO® Hg-LH, and two experimental DARCO® sorbents, DARCO® Hg E-10 and DARCO® Hg E-11. Based on the results from the parametric tests, the project selected a brominated carbon sorbent, DARCO® Hg-LH, to use during the long-term tests. This was based on it having the highest mercury removal rate and the lowest impact on plant particulate emissions.

For the bulk of both the initial and repeat parametric testing, ADA-ES used a portable injection system for ease of transitioning between sorbents but used the permanent silo system for sorbent injection for the last part of the parametric testing.

Data from the second series of parametric tests agreed with the results of the initial, abbreviated parametric tests and supported the decision to use DARCO® Hg-LH as the long-term testing sorbent. Figure 4, *Combined Parametric 1 and 2 – Removal vs. Injection Concentration*, shows that during both parametric tests, the Hg-LH sorbent performed better than the Hg sorbent. It also shows that the performance for all four sorbents was significantly better during the first parametric series compared to the second parametric series.

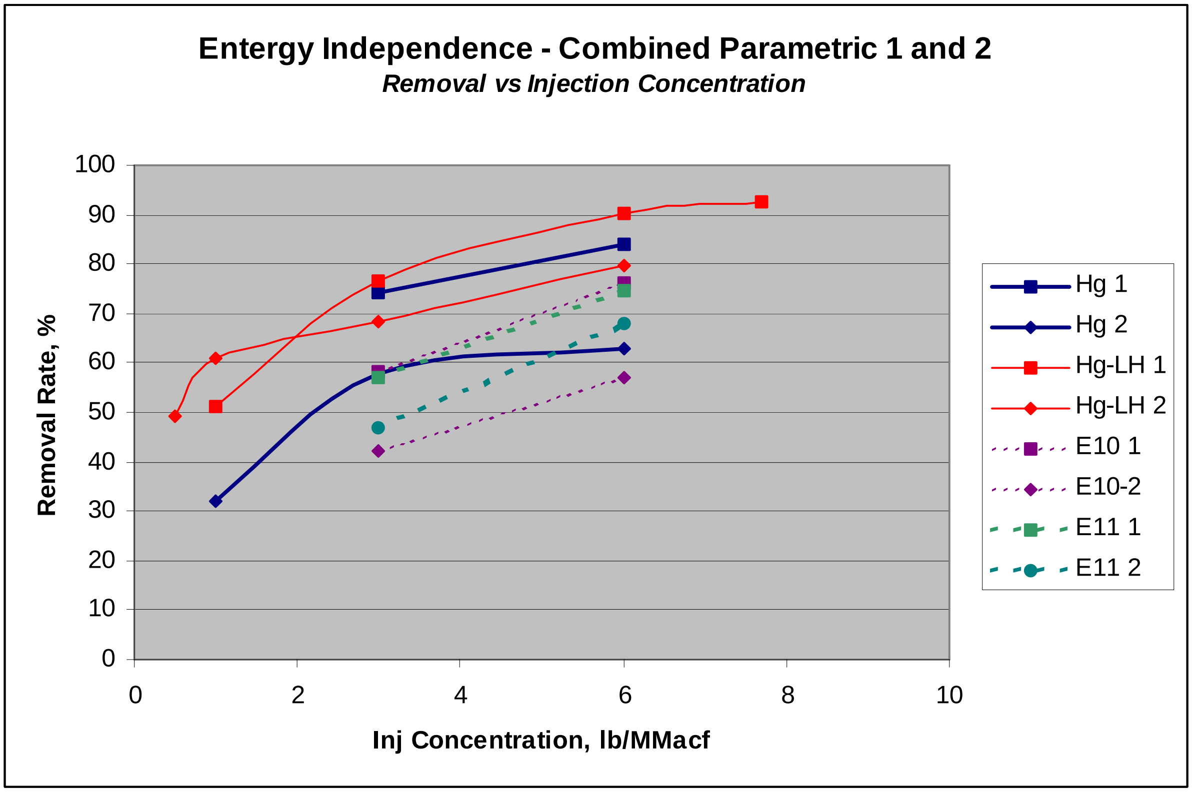

Figure 4. Combined Parametric 1 and 2 – Removal vs. Injection Concentration.

The particulate and opacity spiking observed during the initial parametric test for DARCO® Hg appears to be related to reduced ESP power levels and plate rapping. Testing at the very beginning of the long-term testing sequence with full ESP power and varying the rapping sequence eliminated the particulate and opacity spikes. Figure 5, *DARCO® Hg-LH – Opacity vs. ESP Power*, shows this trend with DARCO® Hg-LH. On the figure, data on October 10, 2005, show only minor opacity variations with the power levels at approximately 70 kW. However, for comparison, on October 11 and 12, 2005, with the ESP power levels reduced to approximately 50 kW, there is a marked opacity spike each hour that corresponds to the ESP Field 7 plate rapping cycles.

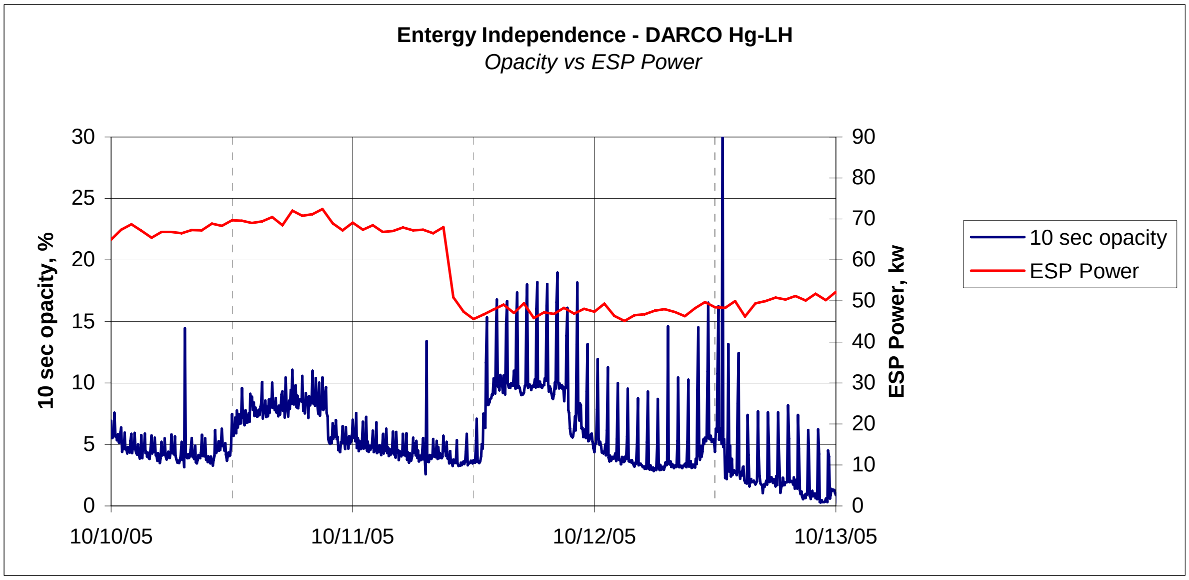

Figure 5. DARCO® Hg-LH – Opacity vs. ESP Power.

Long-Term Tests

October 10–November 7, 2005

Please refer to the previous project quarterly reports for specific information on the long-term testing.

In summary, the long-term testing used DARCO® Hg-LH, injected in front of ESP Field 5 (F5 on Figure 6) and in front of ESP Field 7 (F7 on Figure 6), with injection concentrations of 3, 4, and 5 lb/MMacf.

The removal varied significantly with unit load, increasing with reduced load and decreasing with increased load, which is uncharacteristic based on data from other testing programs at other sites. The testing results also indicated that injecting in front of ESP Field 5, which provided a higher PAC collection area (SCA of 270), resulted in a higher removal rate than when injecting in front of ESP Field 7 (SCA of 135). For the brief period where we injected in front of both fields during the parametric testing, there was no improvement in removal rates above what we experienced with the ESP Field 5 injection.

For a brief period during the testing, the plant burned a coal from the ColoWyo Mine rather than the normal PRB coal, which is significantly lower in mercury. For this period, the mercury removal rate appeared to be approximately the same as with PRB coal.

There did not appear to be any observable impact on ESP operation during any of the long-term testing with the exception of the opacity spiking occurrences when operating at reduced ESP power levels. This conclusion is based on no noticeable differences in operating characteristics such as power levels, sparking rates, plate cleanliness, ash hopper emptying characteristics, ash handling system operation, material buildup inside the ESP boxes, etc.

Summary of Testing Results

Figure 6, *Parametric and Long-Term – Injection Concentration vs. Removal*, plots the approximate removal rates with various injection concentrations during both the initial and second parametric test sequence, as well as the long-term tests. The higher removal rates during the long-term testing occurred during lower unit load, and the lower removal rates occurred during higher unit load. The points generally show that removal rate increases with injection concentration. This trend agrees with the general trends from other testing programs, although for the TOXECON II™ process, the injection concentration for a given removal rate is higher. The Topical Report will further address the specific findings and conclusions of the testing efforts.

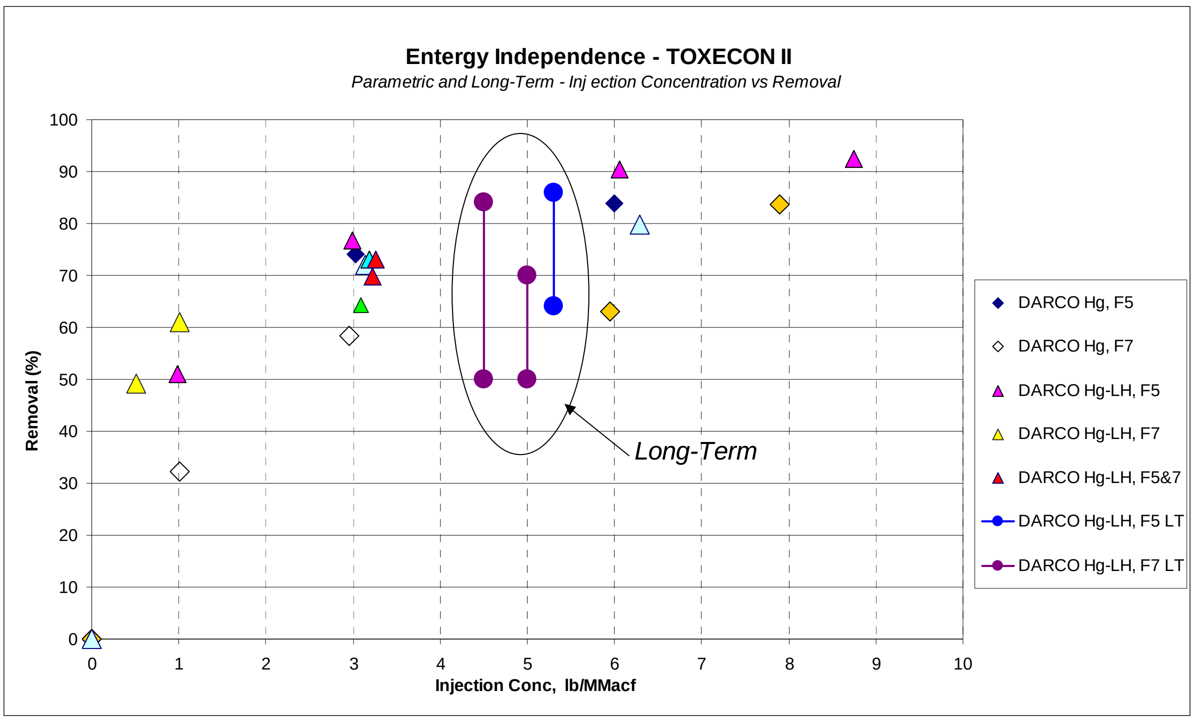

Figure 6. Parametric and Long-Term – Injection Concentration vs. Removal.

Ash Recycle Tests

November 9–12, 2005

As a separate part of the overall program, it is of interest to evaluate the effectiveness of using a recycled PAC/ash mixture for mercury control. Following the long-term testing efforts, ADA-ES transferred an amount of the PAC/ash mixture from the ash silo into the injection storage silo, and injected the mixture in front of ESP Field 5 at injection concentrations of 1, 2, and 4 lb/MMacf (feed rate based on combined mixture, not the carbon fraction). During the first two days of this testing, the plant burned ColoWyo coal, then switched back to PRB on the third day. We halted testing on November 13 because of evidence of pluggage in the Field 5 injection grid.

For the period of data collection during the ash recycle test, the removal rate was significantly less compared to virgin carbon. See Figure 7, *Entergy Independence – Ash Recycle, Mercury Removal*, for the measured removal rates during the Ash Recycle Testing efforts.

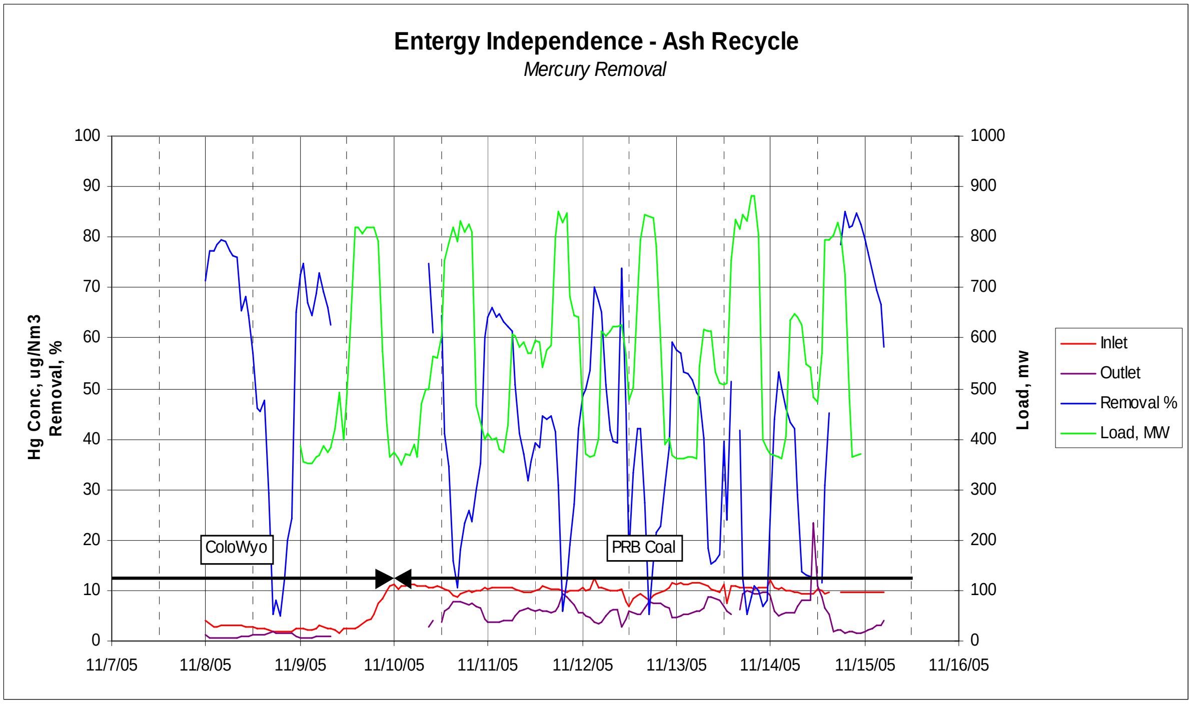

Figure 7. Entergy Independence – Ash Recycle, Mercury Removal.

As stated above, during this testing the injection of the carbon/ash mixture caused pluggage in the ESP Field 5 injection grid. We confirmed this during a subsequent inspection of the injection grid. While we are not sure of the cause, we have noticed on previous project testing that there is a difference in material handling characteristics and density of the carbon/ash mixture compared to either ash or carbon alone.

MidAmerican Louisa – High-Temperature Sorbents

Site Description

MidAmerican's Louisa Station is a test site for high-temperature sorbents/reagents. This plant has a hot-side ESP and uses a proprietary liquid reagent, ADA-37, for flue gas conditioning for ESP performance.

The Louisa Generating Station consists of a single 700-MW PRB coal-fired electric generating unit.

This unit is a balanced draft Babcock & Wilcox front and rear wall-fired boiler with two Ljungström regenerative air heaters, and a Research-Cottrell hot-side electrostatic precipitator. The ESP for this unit has four boxes in a paired box split wedge arrangement, with each box consisting of 27 transformer/rectifier (T/R) sets, 3 chambers, 51 gas passages, 5 fields, and 8 bus sections. The gross SCA at design flow is 459 ft^2/kacfm. The plant burns PRB coal.

The inlet and outlet ducts for each pair of boxes are split into two separate ducts. The existing flue gas conditioning system at Louisa injects the reagent into the entire ESP. The ESP inlet mercury measurement occurred in the duct going to one pair of ESP boxes. This is one-half of the total flue gas flow. Outlet mercury measurements occurred in the stack at the 400-foot emissions monitoring elevation.

The ash handling system at the plant only has one storage silo. It would therefore be impossible under the current configuration to segregate an ash/reagent mixture from non-reagent-laden ash. Since Louisa sells its fly ash, it was important that the reagents used during testing would not impact the marketability of the fly ash.

For collection of plant operating data, the plant connected a workstation that was located in the testing office trailer to the plant control and information system. This made the necessary plant data immediately available to the testing efforts for data logging and real-time observation.

Field Testing

General

During 1Q06, based on investigations, ADA-ES was not able to identify any additional liquid pre-ESP injected mercury removal reagents for testing. Thus, ADA-ES decided to test the flue-gas conditioning reagent ADA-37 at various injection levels for mercury removal, and, based on discussions with the plant and host utility, decided to test ALSTOM KNX halogenating reagent at various injection rates to evaluate its impact on mercury speciation.

The testing at Louisa consisted of evaluating whether the ESP flue gas conditioning reagent (ADA-37) affected the mercury removal across the ESP. It also included evaluating if a halogenating reagent (ALSTOM KNX) applied to the coal before it enters the pulverizers would affect the mercury speciation in the flue gas and the mercury removal across the ESP.

The testing at this site was a two-week test for baseline and parametric testing only on liquid reagents, using the existing flue gas conditioning equipment for reagent injection just upstream of the ESP, and a temporary metering pump arrangement for adding a halogenating reagent to the coal feeders just before the coal enters the pulverizers.

Mercury measurements occurred upstream of the pre-ESP liquid injection location and downstream of the ESP at the 400-foot level in the stack to determine mercury removal rates.

Generally, the testing showed that there was little or no removal as a result of injecting the ADA-37 flue gas conditioning reagent in front of the ESP. However, there was significant increased speciation of the mercury in the flue gas a result of the injection of the ALSTOM KNX reagent on the coal as it went into the coal mills.

ADA-37 Tests

An earlier (1999) mercury characterization test at Louisa indicated that the post-ESP mercury levels were lower than the pre-ESP levels when injecting the flue gas conditioning reagent (ADA-37) upstream of the ESP. This previous observation formed the basis for doing the parametric testing of ADA-37 at Louisa.

During this testing, we were able to change the injection rate of the ADA-37 reagent from zero up to 1.5 times the normal injection rate, without risking an opacity excursion since the ESP had come off line for a cleaning just prior to the mercury testing program and had gone through a two-week normal preconditioning sequence following the outage.

Mercury measurement for the ESP outlet used a Thermo iSeries mercury analyzer system installed at the 400-foot level of the stack. Mercury measurement at the ESP inlet used a SCEM located at one of the ESP inlet ducts. ADA-ES contracted with Apogee Scientific to perform the ESP inlet monitoring activities using their analyzer equipment.

The Thermo iSeries analyzer is a recently released mercury CEM. The testing at Louisa was the first installation of this specific analyzer unit. During the setup and initial operation of this unit at Louisa, we encountered problems with ambient temperature swings in the installation area because the unit was not installed in a temperature-controlled environment, which in turn caused erratic analyzer readings. We were able to determine the cause of the erratic readings and, with a combination of getting better control on the temperature variation in the installation area as well as modifying the analyzer components to be able to accept a wider range of operating ambient temperatures, we were able to achieve normal analyzer operation.

The ADA-37 testing consisted of injecting the flue gas conditioning reagent at rates of 0, 6, 12, and 18 gallons per hour for varying periods of time and observing the change in mercury levels across the ESP. There was sufficient ESP preconditioning so that the plant did not see any change in plant opacity when operating with no reagent injection. The normal flue gas conditioning injection rate is 12 gallons per hour, which the plant injects at a constant rate independent of unit load.

During this testing period, which lasted about a week, we obtained several STM collections as well as an EPA Method 26 sampling when injecting ADA-37 at 6 gallons per hour.

While the data analysis for the testing continues, the preliminary results indicate that there was no change in mercury removal with varying ADA-37 injection rates, including periods with no injection.

Figure 8, *Louisa Parametric Testing – ESP Inlet and Stack HgT*, shows the inlet and outlet mercury measurements with varying ADA-37 injection rates. During the first several days, as noted on the figure, we experienced operating abnormalities on the Thermo Hg CEMS due to varying ambient temperatures of the equipment. After resolving these abnormalities, the unit operated properly. While the outlet readings are slightly higher than the inlet readings for some parts of testing, we attribute this to the difference in CEM types between the inlet analyzer and the outlet analyzer.

While there appears to be a downward trend in the overall mercury levels during the KNX injection period, we believe this is purely coincidental and not associated with the KNX injection.

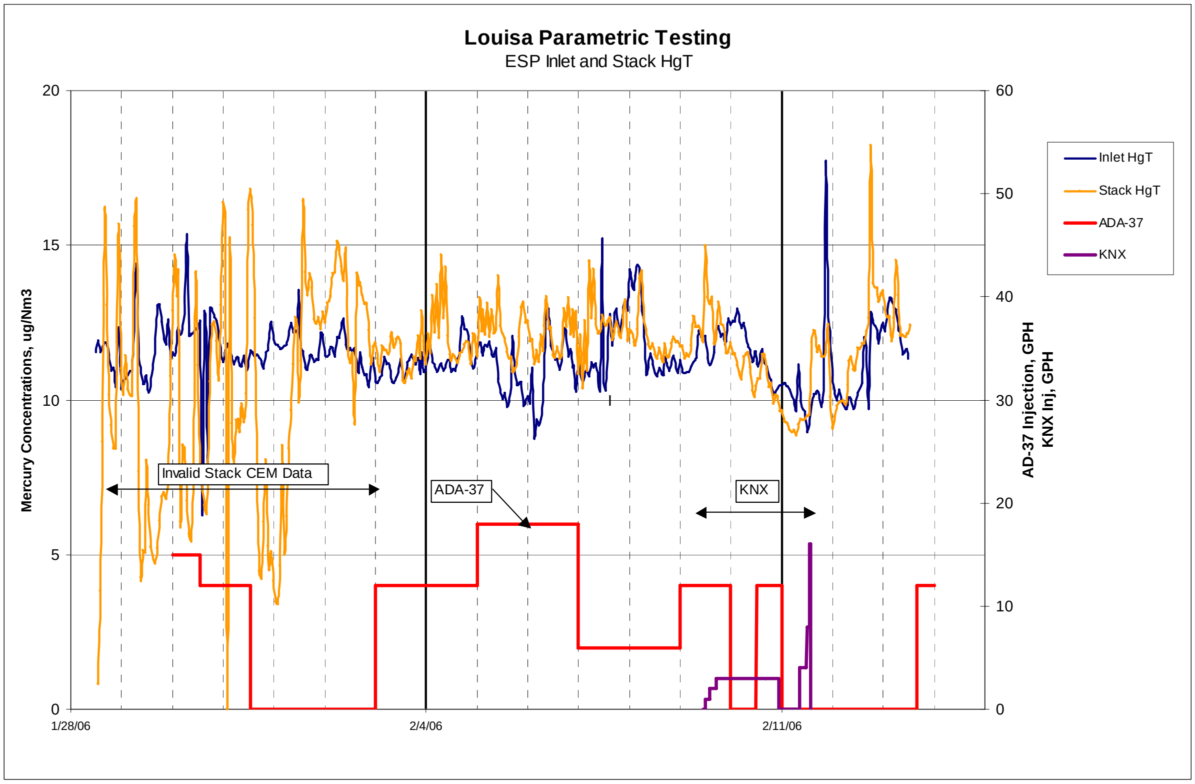

Figure 8. Louisa Parametric Testing – ESP Inlet and Stack HgT.

ALSTOM KNX Tests

As a part of this testing effort at Louisa, the project injected ALSTOM's KNX reagent at various rates to observe if any changes occurred in mercury speciation.

The injection arrangement consisted of injecting the ALSTOM KNX product on the belt in the coal feeders just before the coal went into the pulverizers. The unit has seven pulverizers, and we were able to inject into the feeders on four of the mills (mills 101, 102, 103, and 104). This added the reagent to four burner elevations—two on the front wall and two on the rear wall. We believe that this injection arrangement gave a relatively uniform distribution within the furnace. We could not detect any stratification at the inlet to the precipitator. See Figure 9, *Louisa Boiler with Mill and Burner Arrangement*, for a diagram of the boiler showing the burner arrangement and the associated coal mill for each burner level.

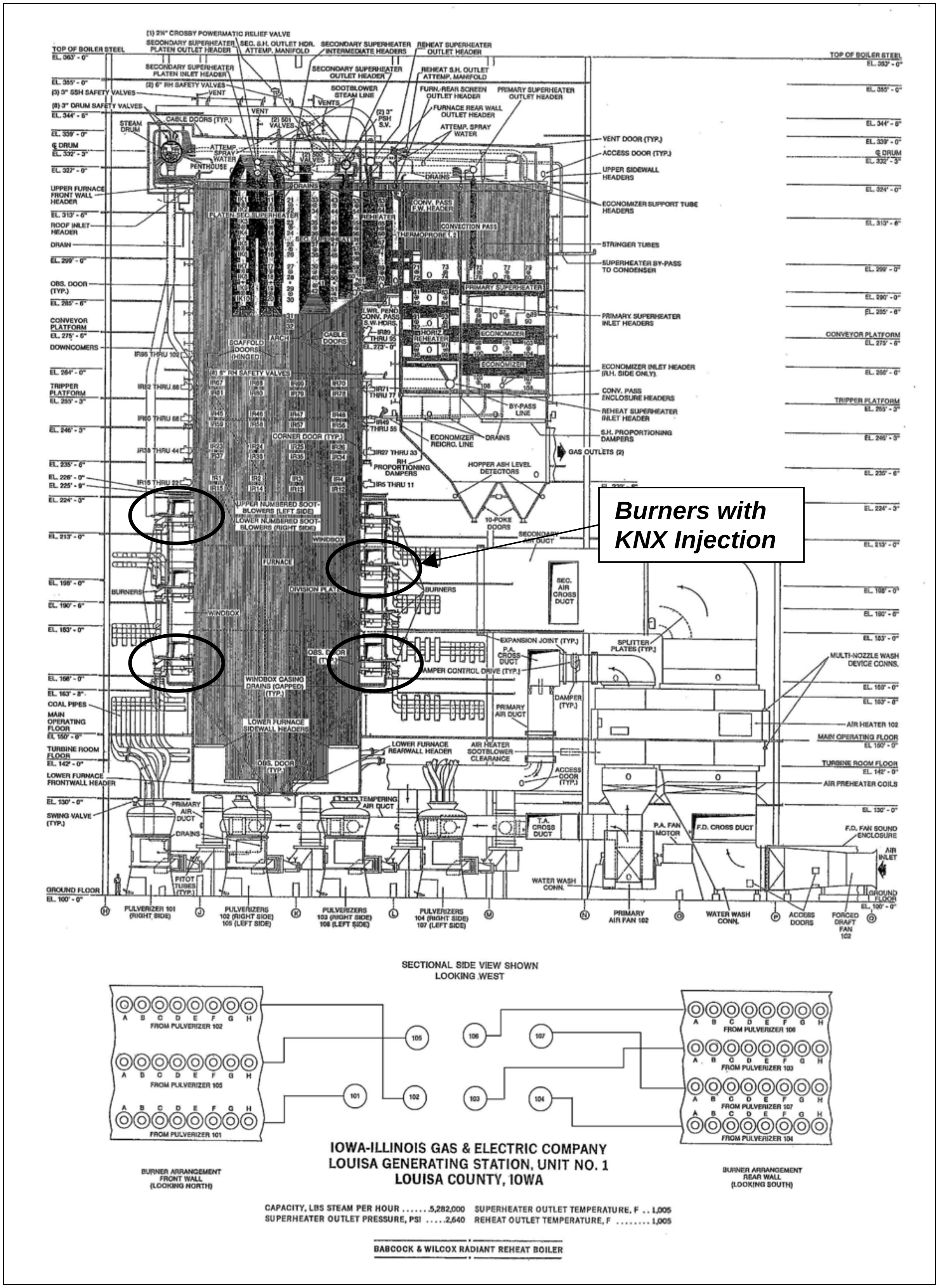

Figure 9. Louisa Boiler with Mill and Burner Arrangement.

Figure 10, *MidAmerican Louisa Station Mercury Speciation vs. KNX Injection Rate*, shows the plot of the KNX injection rate and the resulting elemental mercury at the ESP inlet as well as in the stack. Even though this was a very short duration test, the plots show that with a 3 gallon per hour application rate, there is a decrease in elemental mercury. Analyzing the mercury removal rate across the ESP, however, does not show any conclusive change in ESP mercury removal. There was no difference in mercury oxidation during injection of KNX when we shut off the ADA-37 injection. The small amount of data for oxidized mercury in the stack indicates there is additional mercury oxidation across the ESP, which is normal. We will do further data analysis to quantify these changes.

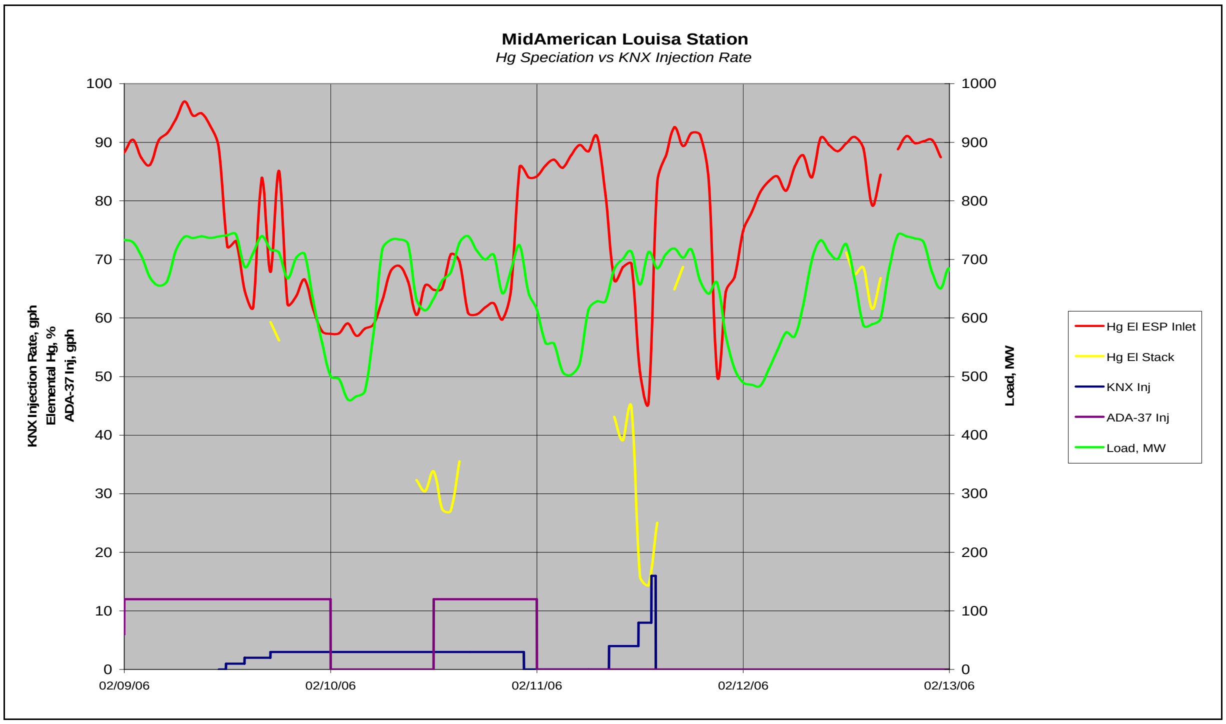

Figure 10. MidAmerican Louisa Station Mercury Speciation vs. KNX Injection Rate.

MidAmerican Council Bluffs Unit 2 – High-Temperature Sorbents

MidAmerican's Council Bluffs Unit 2 is a test site for high-temperature sorbents. This plant has a hot-side ESP with no flue gas conditioning. The project testing at this site will be a typical test effort with baseline, parametric, and long-term tests. Since current carbon-based sorbents have not performed well at elevated temperatures, the sorbents or reagents for this testing will be either non-carbon-based sorbents or reagents or carbon-based sorbents that have shown some mercury removal potential at higher temperatures. These are dry sorbents or reagents that will require the installation of a dry injection system.

The planned test program for this site includes initial screening of a number of potential sorbents from various suppliers for injection in front of the ESP, selecting one or more of the promising sorbents for parametric testing, then selecting one of the sorbents (if any) for long-term testing. The test program also includes investigating the CDEM product MinPlus, which is a sorbent/reagent for injection into the upper furnace where the gas temperature is in the 2000 ºF range.

During 1Q06, ADA-ES solicited various sorbent/reagent suppliers for potential high-temperature materials that could possibly work for this high-temperature application. The intent is to evaluate these sorbents/reagents using a high-temperature sorbent screening device to determine the removal efficiency for each of the materials.

During this reporting period, we received responses from 7 suppliers for a total of 12 sorbent samples. Some materials are still in the lab-scale stages, others are further along in the development stages. Most of these sorbents/reagents are non-carbon-based, but at least one of the suppliers is proposing carbon-based sorbents.

In addition, we tested samples with blank beds, sand beds, and ash beds.

The high-temperature sorbent screening device inserts the actual sorbents contained in a glass enclosure into the flue gas stream, and draws a fixed quantity of flue gas through the enclosure and sorbent bed. Laboratory analysis then measures the amount of mercury the bed collects and, with that data, we calculate the mercury capture in the sorbent bed. At the same time, we take an STM sample of the flue gas (at a lower temperature) exiting the sorbent screening device to measure the mercury in the stream after it passes through the sorbent bed in the sorbent screening device. This indicates the residual mercury in the flue gas after passing through the sorbent and thus is a check on the mercury captured in the bed. The sum of the mercury captured in the bed and the mercury captured in the sorbent screening device is the total mercury in the flue gas.

Figure 11, *High-Temperature Sorbent Screening Device*, shows the basic configuration of the high-temperature sorbent screening device used for this testing.

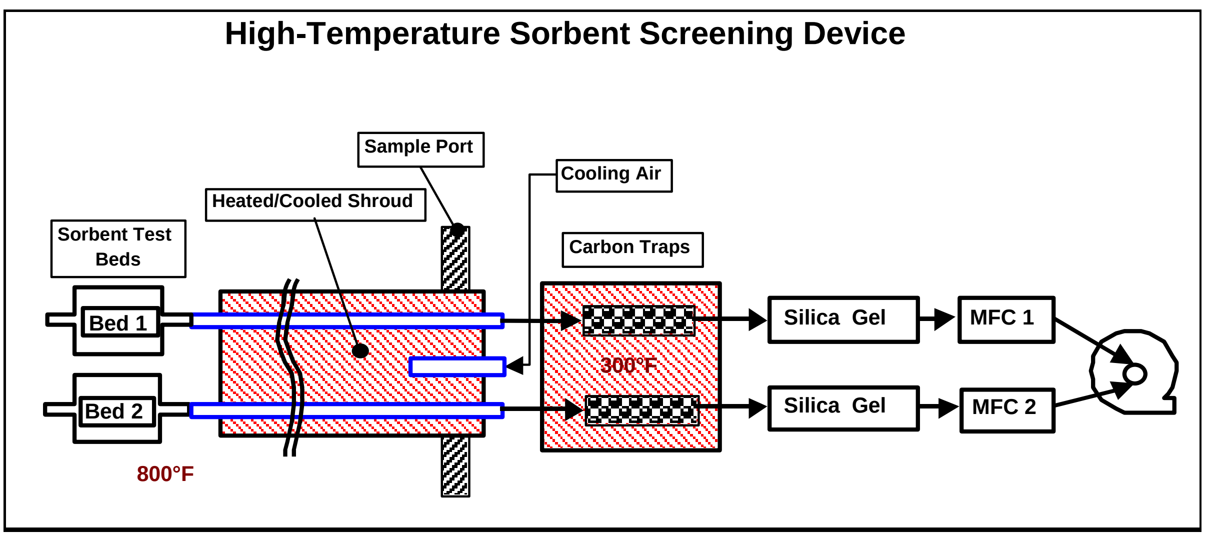

Figure 11. High-Temperature Sorbent Screening Device.

After we received the various sorbent/reagent testing samples for sorbent screening at the front of the ESP, we prepared the samples for sorbent screening testing. We performed the sorbent screening test during the week of April 17, 2006.

Table 2, *MidAmerican Council Bluffs Unit 2 High-Temperature Sorbent Screening*, shows the results of the Council Bluffs Unit 2 sorbent screening tests. Figure 12, *MidAmerican Council Bluffs Unit 2 High-Temperature Sorbent Screening*, shows the results of these tests in a graphic format. Both the table (Hg Removal column) and the figure (Hg in SSD Beds) show that there is very little mercury captured in any of the tested sorbent/reagents.

Table 2. MidAmerican Council Bluffs Unit 2 High-Temperature Sorbent Screening.

MidAmerican Council Bluffs Unit 2 High-Temperature Sorbent Screening - (600°F Flue Gas Temperature)									
Sample Designation	Hg in Bed, ng	Hg in 1st Filter, ng	Total Removed, ng	Hg in Trap, ng	Total Collected Hg, Ng	Hg Removal, %	Gas Conc Bed, ng/Nl	Gas Conc Trap, ng/Nl	Gas Conc Total, ng/Nl
S-1	1.6	3.5	5.1	323.1	328.2	1.554	0.244	15.463	15.707
S-2	2.6	0.4	3.0	370.0	373.0	0.804	0.143	17.682	17.826
S-3	1.7	0.2	1.9	272.9	274.8	0.691	0.092	13.201	13.293
Ash	1.0	0.5	1.5	322.5	324.0	0.463	0.072	15.532	15.605
S-4	1.9	0.2	2.1	269.1	271.2	0.774	0.102	13.026	13.128
Blank		2.2	2.2	289.2	291.4	0.755	0.106	13.936	14.042
S-5	3.1	0.6	3.7	225.7	229.4	1.613	0.178	10.883	11.061
Blank		0.9	0.9	234.9	235.8	0.382	0.043	11.323	11.366
S-6	2.2	0.8	3.0	227.0	230.0	1.304	0.145	10.953	11.098
S-7	2.4	1.1	3.5	235.5	239.0	1.464	0.169	11.350	11.519
S-8	4.2	1.3	5.5	225.5	231.0	2.381	0.265	10.877	11.142
S-9	2.9	1.5	4.4	228.4	232.8	1.890	0.212	11.010	11.222
S-10	2.0	5.7	7.7	244.7	252.4	3.051	0.371	11.801	12.173
S-11	1.7	1.0	2.7	195.7	198.4	1.361	0.130	9.433	9.563

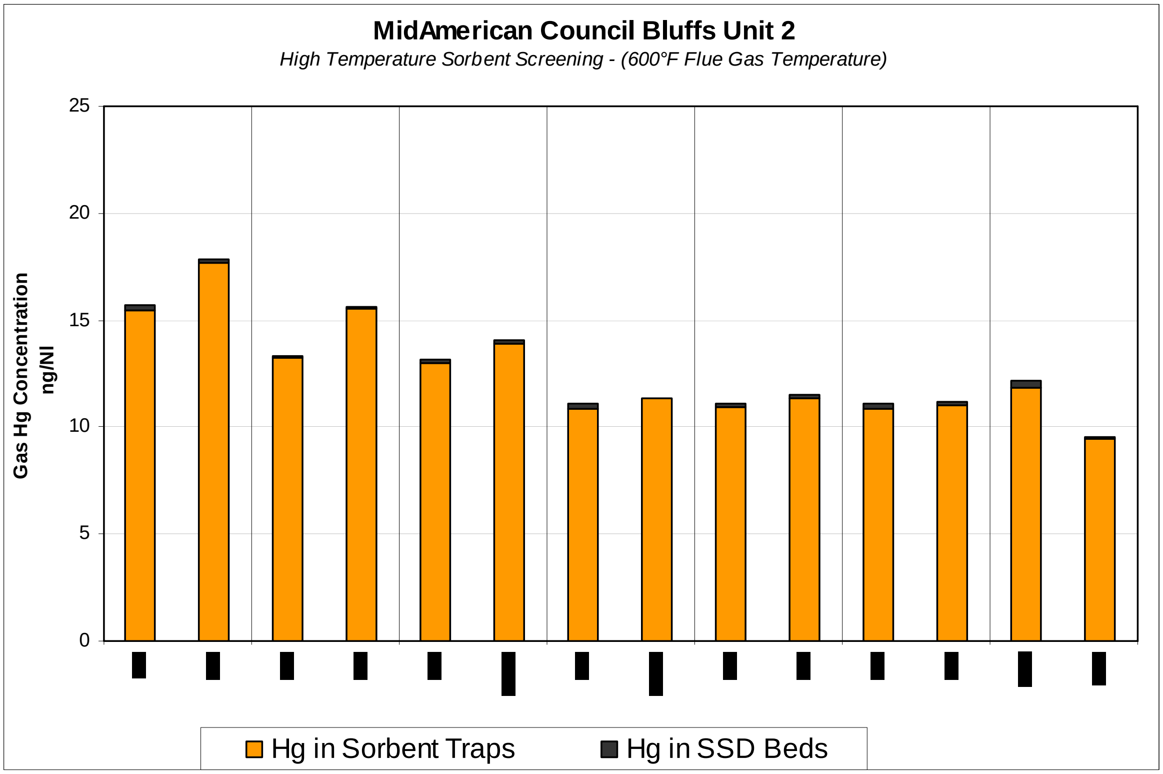

Figure 12. MidAmerican Council Bluffs Unit 2 High-Temperature Sorbent Screening.

Based on the results of the sorbent screening tests, none of the reagents/sorbents showed significant levels of mercury capture in the screening beds.

We will evaluate which of the sorbents/reagents we will consider for parametric testing and arrange with the supplier(s) for the necessary quantities for testing.

Also during this period, we had further discussions with CDEM, who has tested the dry furnace injected chemical additive MinPlus on a small unit and has seen promising results, about the testing efforts at Council Bluffs Unit 2. They are still very interested in this testing effort, and we are currently discussing with them the details of installing a test setup at the plant.

As a part of the furnace injection effort with MinPlus, we received a proposal from Reaction Engineering International (REI) to perform CFD modeling of the furnace and boiler heat recovery area to determine the flow patterns and the temperatures in the furnace as well as the boiler heat recovery area. Figure 13, *Council Bluffs Boiler Section*, shows the general configuration of the furnace and boiler. The probable place for injection is at the furnace nose just below the pendant superheater section. The modeling will provide information for designing the injection system for the furnace, as well as help predict potential mercury removal for this process. We have authorized REI to proceed with this effort, and they are in the process of getting the basic model established. They anticipate completion of these efforts sometime in July or August 2006.

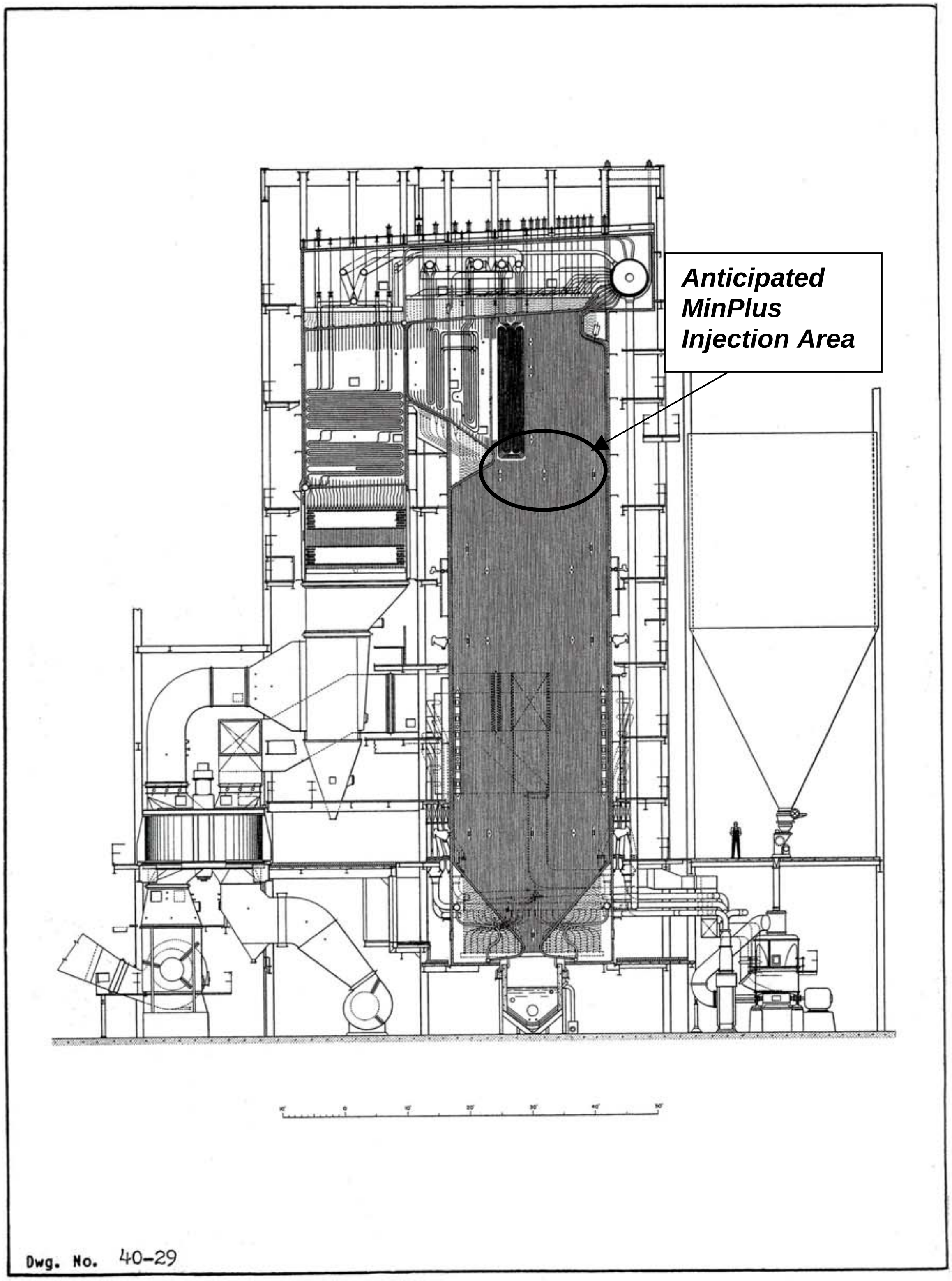

Figure 13. Council Bluffs Boiler Section.

AEP Gavin Station – TOXECON II™

In the original project proposal, AEP's Gavin Station was a possible site for TOXECON II™ testing in 2007. After further investigation, AEP has questioned the applicability of this site for a TOXECON II™ test because of the site configuration and operational characteristics. The project is investigating other possible power plant sites for this testing.

We continue to evaluate potential sites that will meet the project objectives. Testing at this site is currently scheduled for sometime in 2007.

Conclusion

Overall, the project is progressing generally on schedule with no known concerns.

MILESTONES NOT MET

None.

COST STATUS

See form SF-269A included in the appendix.

SUMMARY OF SIGNIFICANT ACCOMPLISHMENTS

1. At Independence, we completed most of the sample testing using outside laboratories, and are continuing with the data analysis portion of the program for this site. The site Topical Report is in progress.
2. ADA-ES completed the high-temperature liquid reagent/sorbent testing at MidAmerican Louisa Station.
3. ADA-ES completed the high-temperature sorbent screening tests using solid sorbents/reagents at MidAmerican Council Bluffs Unit 2.
4. ADA-ES has submitted abstracts to a number of conferences to present the ongoing results and project progress, and various conferences have accepted these papers for presentation.

ACTUAL OR ANTICIPATED PROBLEMS OR DELAYS

None.

DESCRIPTION OF TECHNOLOGY TRANSFER ACTIVITIES

A number of utilities, including the owners of a four-unit, 3200-MW plant, expressed interest in extending the testing at Independence to further demonstrate the commercial applicability of the TOXECON II™ process for mercury removal, in anticipation of using that technology as a permanent approach to mercury removal in place of other more-expensive arrangements. As a result, EPRI has sponsored an extended testing program at Entergy's Independence Station for this demonstration.

This demonstration is ongoing. It has addressed the concerns for lower-than-expected removal rates achieved during the long-term testing for this project. This testing indicates that the TOXECON II™ injection grid may not be getting a good PAC distribution in the ESP, which would be an explanation for the lower-than-expected removal rates. As a result, the EPRI program is proceeding with analyzing the injection grid distribution patterns through CFD modeling, with the intent of installing a revised grid design and measuring the resulting removal rates.

There continues to be widespread interest in proving the TOXECON II™ technology. ADA-ES has submitted abstracts to a number of conferences to present the ongoing results and project progress, and various conferences have accepted these papers for presentation.

APPENDIX

FINANCIAL STATUS REPORT

(Short Form)

(Follow instructions on the back)

1. Federal Agency and Organizational Element to Which Report is Submitted	2. Federal Grant or Other Identifying Number Assigned By Federal Agency	OMB Approval No.	Page of 2 pages
DOE/NETL	DE-FC26-05NT42307	**0348-0039**	1

3. Recipient Organization (Name and complete address, including ZIP code)

ADA-ES, Inc.
8100 SouthPark Way Unit B Littleton, CO 80120

4. Employer Identification Number	5. Recipient Account Number or Identifying Number	6. Final Report	7. Basis
84-1341182		☐ Yes ☑ No	☐ Cash ☑ Accrual

8. Funding/Grant Period *(See Instructions)* From: (Month, Day, Year)	To: (Month, Day, Year)	9. Period Covered by this Report From: (Month, Day, Year)	To: (Month, Day, Year)
02/10/2005	02/09/2008	04/01/2006	06/30/2006

10. Transactions:	I Previously Reported	II This Period	III Cumulative
a. Total outlays	1,832,568.03	223,520.37	2,056,088.40
b. Recipient share of outlays	505,788.78	61,691.63	567,480.41
c. Federal share of outlays	1,326,779.25	161,828.74	1,488,607.99
d. Total unliquidated obligations			0.00
e. Recipient share of unliquidated obligations			0.00
f. Federal share of unliquidated obligations			0.00
g. Total Federal share *(Sum of lines c and f)*			1,488,607.99
h. Total Federal funds authorized for this funding period			3,946,323.00
i. Unobligated balance of Federal funds *(Line h minus line g)*			2,457,715.01

11. Indirect Expense

a. Type of Rate *(Place "X" in appropriate box)* ☑ Provisional ☐ Predetermined ☐ Final ☐ Fixed

b. Rate	c. Base	d. Total Amount	e. Federal Share
see attached	$95,565.81	$127,954.56	$66,262.93

12. *Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation.*

13. Certification: **I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.**

Typed or Printed Name and Title	Telephone (Area code, number and extension)
Richard Schlager, Vice President	(303) 734-1727
Signature of Authorized Certifying Official	**Date Report Submitted**
Richard Schlager	7-18-06

Previous Editions not Usable

Standard Form 269A# (REV 4-88)
Prescribed by OMB Circulars A-102 and A-110